SD391
R6
#7

SILVICULTURE OF ASPEN FORESTS

IN THE ROCKY MOUNTAINS AND THE SOUTHWEST

by Wayne D. Shepperd

USDA Forest Service
Rocky Mountain Forest and Range Experiment Station
Fort Collins, Colorado

RM-TT-7

LIBRARY COPY
ROCKY MT. FOREST & RANGE
EXPERIMENT STATION

PREFACE

Aspen (*Populus tremuloides* Michx.) is the only hardwood species currently being managed in the Rocky Mountain and southwestern regions. A true multi-resource species, aspen in some way affects all natural resource management disciplines in the West. From a silvicultural standpoint, aspen behaves quite differently than its associated conifer species. Selection of a silviculture system to manage aspen within the reality of conflicting resource uses can become quite complex. It is important that all resource managers understand the silvical characteristics of aspen and the management options which are available in order to select the proper silvicultural treatment.

This booklet and the accompanying slide-tape presentation are designed to provide a concise summary of the ecology and silvicultural practices available for aspen forests in the Rocky Mountains and Southwest. Please keep this booklet as a handy reference to help you recall the subjects presented in the talk. This slide-tape presentation has been distributed to the Intermountain, Rocky Mountain, and Southwestern Regions. Information concerning the purchase of additional copies of this or other slide-tape and booklet sets in this series can be obtained by writing:

Public Affairs Officer
USDA Forest Service
Rocky Mountain Forest and Range Experiment Station
240 West Prospect
Fort Collins, CO 80526

If you desire more information about aspen management, a much more comprehensive and technical summary of subjects covered in this booklet is presented in the following publication:

DeByle, Norbert V., and Robert P. Winokur, editors. 1985. Aspen: Ecology and management in the western United States. USDA Forest Service General Technical Report RM-119, 283 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
Copies can be purchased as Stock No. 001-001-00617-3 from Superintendent of Documents, Washington, D.C., 20402 at a current price of $8.50.

ACKNOWLEDGEMENTS

The author wishes to thank Glen Crouch, Thomas Hinds, and John Schmid of the Rocky Mountain Station for their valuable input to this publication. Elaine Zieroth, John King, and others who contributed much needed slides also deserve special recognition.

March 1986

Silviculture of Aspen Forests in the Rocky Mountains and Southwest

Wayne D. Shepperd, Silviculturist

Rocky Mountain Forest and Range Experiment Station[1]

USDA Forest Service
RM-TT-7

[1]*Headquarters is in Fort Collins, in cooperation with Colorado State University.*

TABLE OF CONTENTS

Page

Introduction 3

Stand Conditions 6
- Occurrence 6
- Succession 6
- Age Distribution 9

Damaging Agents 11
- Insects 11
- Canker Diseases 12
- Decay 14

Regeneration 15
- The Natural Regeneration Process 15
- Clonal Differences 16
- Suckering Characteristics 18

Regeneration Silviculture 21
- Factors to Consider 21
- Layout of Regeneration Units 22
- Alternative Methods 25
  - Fire 25
  - Bulldozing 26
  - Herbicides 26
  - Partial Cutting 27

Deteriorating Stands 29
- Identification 29
- Protective Measures 31

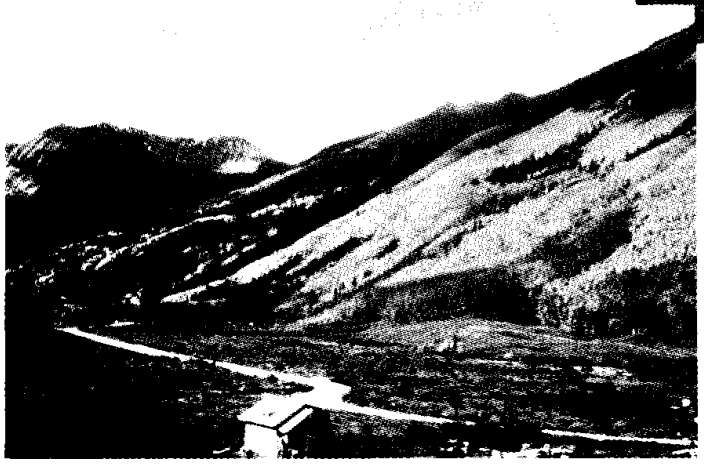
Factors Affecting Regeneration Success 32
- Quantity of Suckering 32
- Browsing 33
- Small Animals 34
- Snow 34
- Disease 35
- Associate Vegetation 35

Conclusion 36

1

2

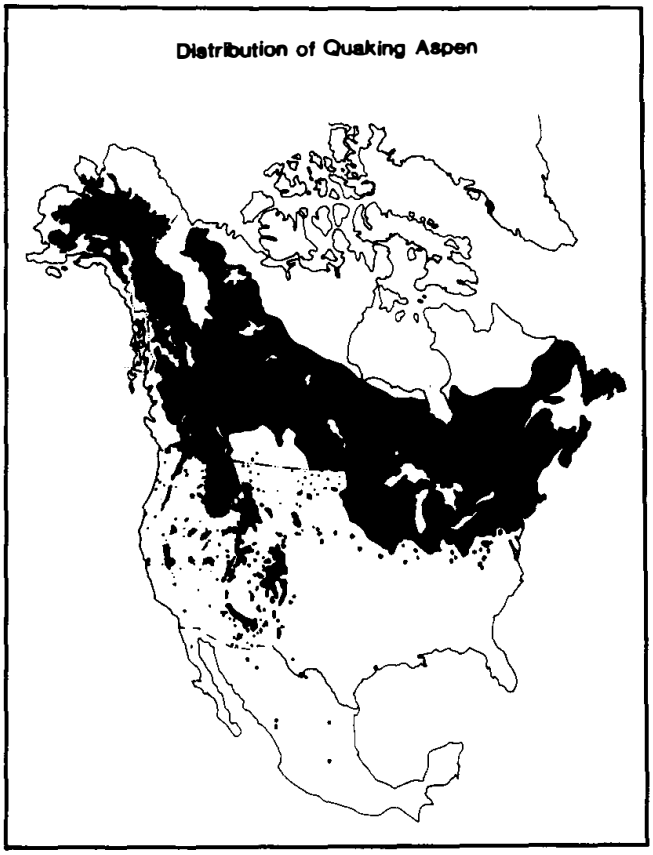
3



4

1. . . **2**. . . **3**. . . music. . .

4. Aspen. . . the very name calls to mind an image of beauty, serenity, and autumn splendor.



5

5. Aspen is one of the most widely distributed tree species in the world, yet, is the tree which best typifies the rugged beauty of Rocky Mountain and southwestern forests.

6. The several million acres of aspen in the central Rockies not only furnish . . .

7. . . . important recreational and scenic areas, . . .

8. . . . they also provide valuable wildlife habitat . . .

9. . . . and represent a largely un-utilized fiber resource.

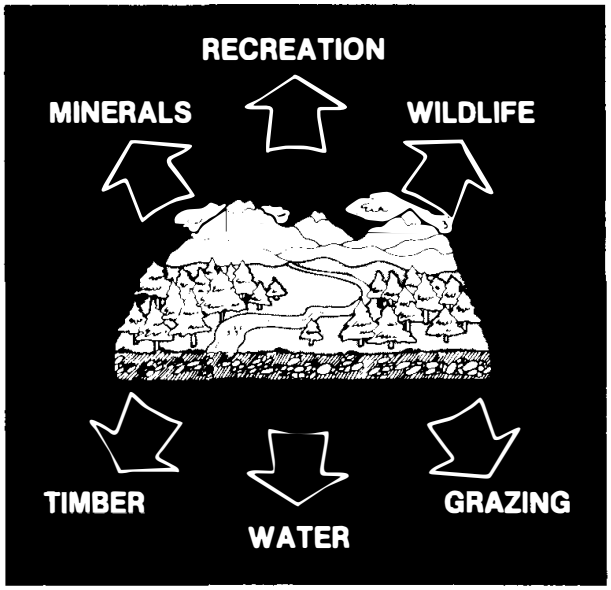
8

6

9

7

4



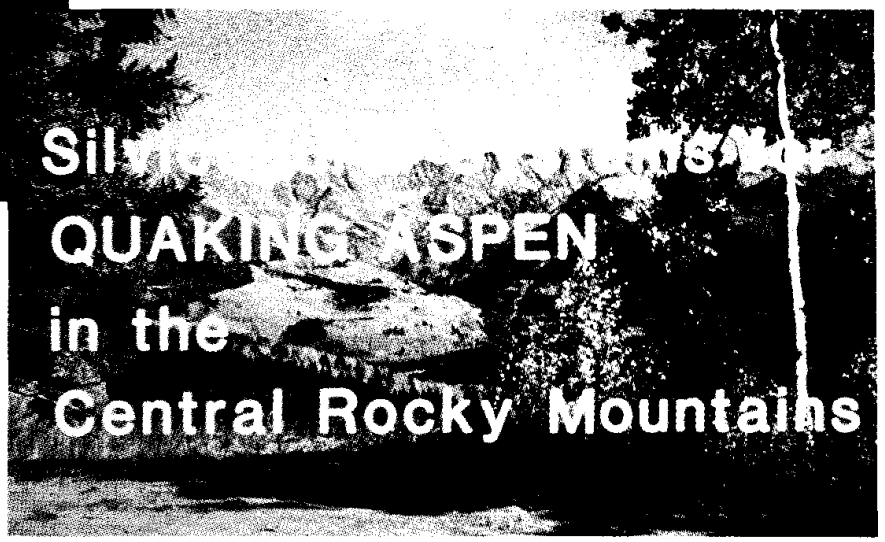
10

10. Today, forest managers must manipulate aspen stands to meet management objectives for all of these resources.

11. This program, plus the introductory overview and companion slide tapes, are designed to help you make better silvicultural decisions to manage forests in the central and southern Rocky Mountains.

12...**13**... Music...

11



12

13

14

A. Stand Conditions
B. Damaging Agents
C. Regeneration
D. Regeneration Silviculture

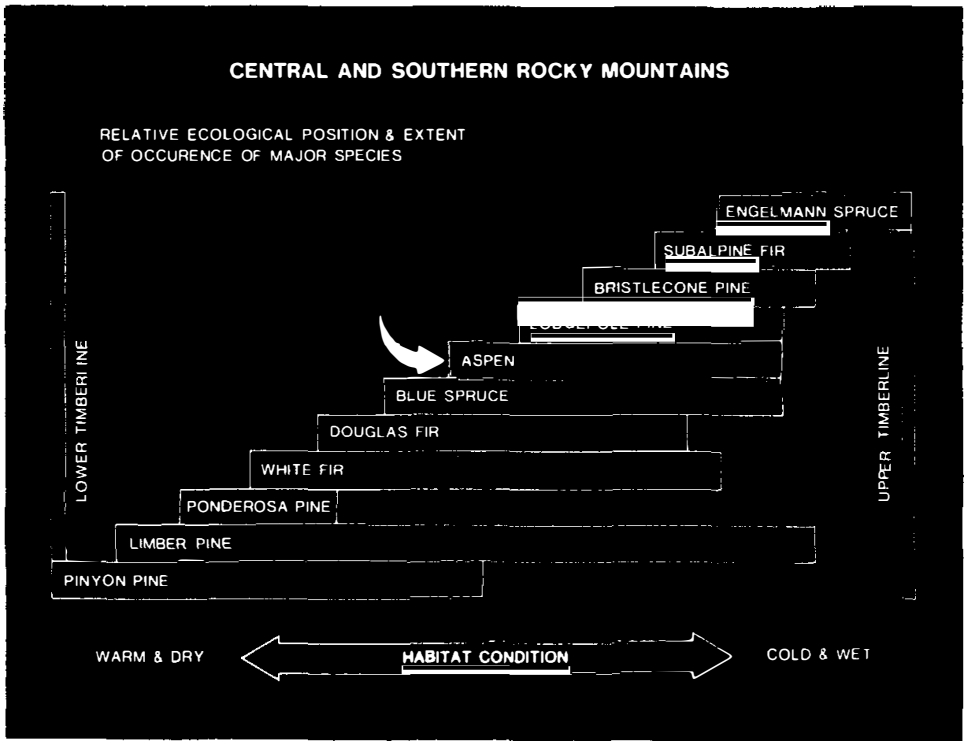
14. As we proceed, we'll look at several aspects of aspen silviculture. First, we'll discuss stand conditions and clonal characteristics. Then, we'll go on to damaging agents, discuss how aspen stands reproduce, and the silvicultural methods we can use. Finally, we will examine some factors which can affect regeneration success.

STAND CONDITIONS

15

15. Aspen forests occur throughout the central Rockies and the higher elevations in Arizona and New Mexico associated with both montane and subalpine vegetation along a broad elevational and moisture gradient.

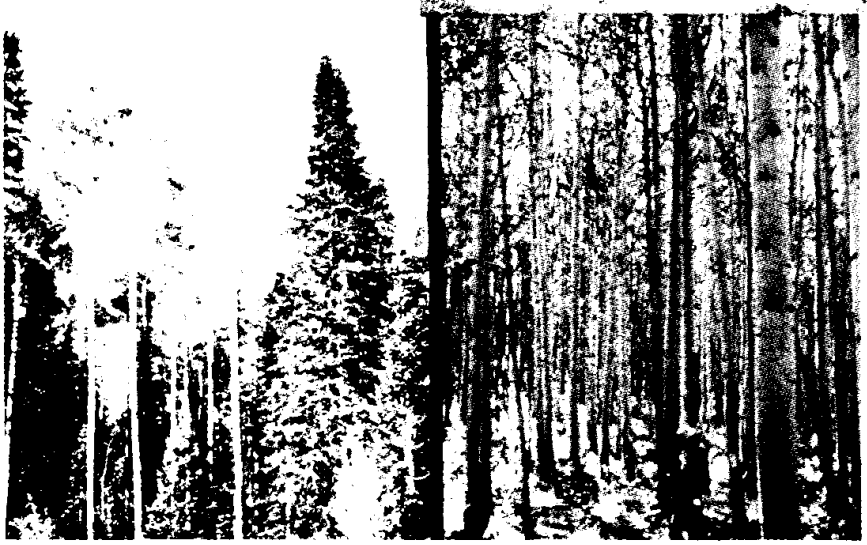
16. Aspen stands can be found on all aspects and slopes in a broad altitudinal range, but the most extensive stands occur between 8,500 and 10,000 feet elevation.



16

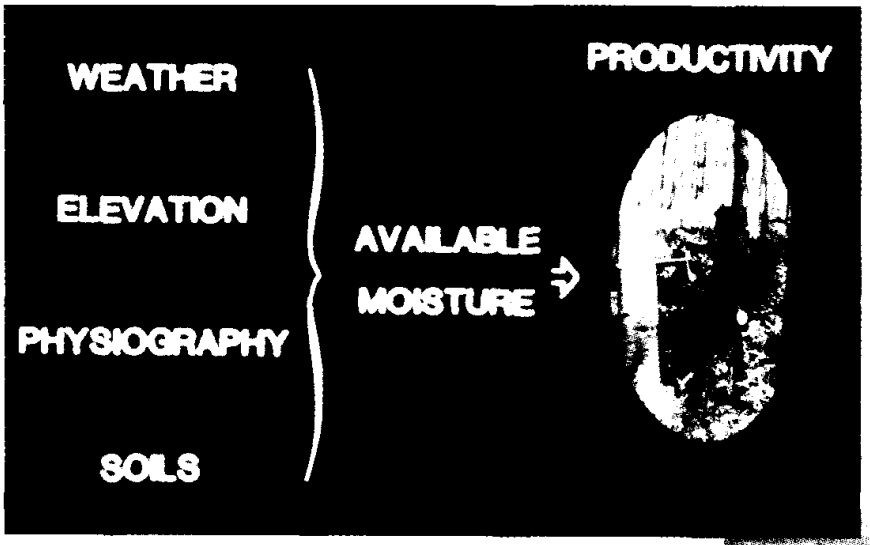
17

18



17. A seral species, usually invading after fire or other major disturbance,. . .

18. . . .many aspen stands are eventually replaced by conifer forests. However, pure aspen stands occur which do not contain conifers. For management purposes, these stands can be considered a stable or climax vegetation type.



19

19. Productivity and development of aspen in the Rockies depends upon available moisture which, in turn, is related to weather patterns, elevation, physiographic position, and soil characteristics.

20. For example, stands on the west slope of the Continental Divide occupy large areas on all physiographic positions,. . .

20

21

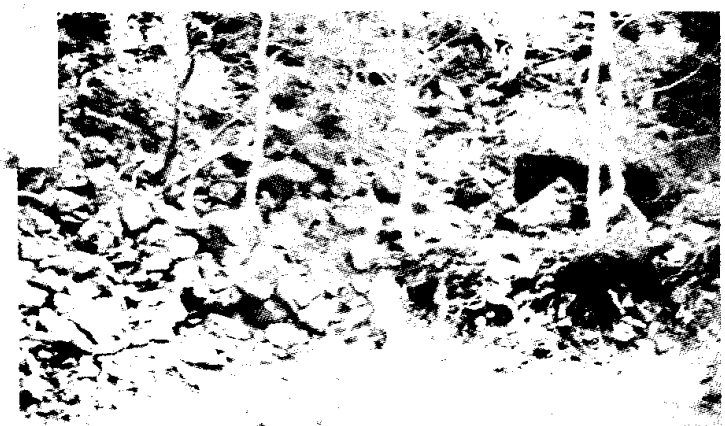
22

21. . . . but stands on the drier east slope grow mostly in bottoms, draws, and other areas where water is more available.

22. Aspen stands can be found on a variety of soil types from loamy sands to heavy clays.

23. Rocky soils limit stand development, . . .

24. . . . and the most productive stands are found on deep, well-developed, moist soils.



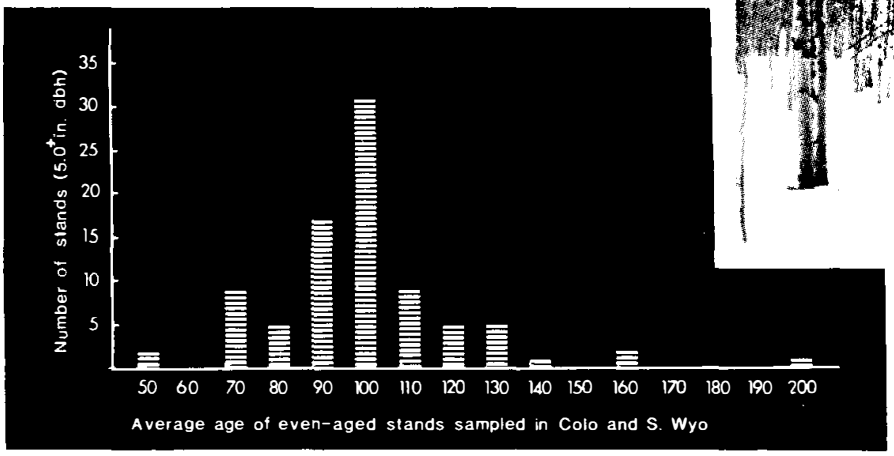
23

24

25. Aspen grows in a wide range of climates in the Rocky Mountains and Southwest. Annual precipitation can range from 16 to 40 inches per year, most of which is received as snow.

25

26



26. Another interesting feature of aspen in the Rocky Mountains is their age. The average age of most stands is around 100 years with the majority being between 70 and 120 years of age.

27

27. Younger stands are rare and found only where there has been a recent disturbance or disease outbreak to kill the overstory and trigger reproduction.

28. The result is an overabundance of stands in the mature to overmature age classes. While 80 to 120 years seems relatively young by western conifer standards, aspen seldom persists to these ages in other parts of its range.

28

29

29. Not all western aspen stands are even-aged. The multistoried stand structure in this stand indicates two or more age classes are present.

30

31

30. Mature aspen stands also provide understory forage and thermal cover for large animals, and homes to many species of small mammals and birds.

31. Where present, young aspen stands provide valuable browse for several years, but . . .

32

32. . . . intensive browsing can contribute to . . .

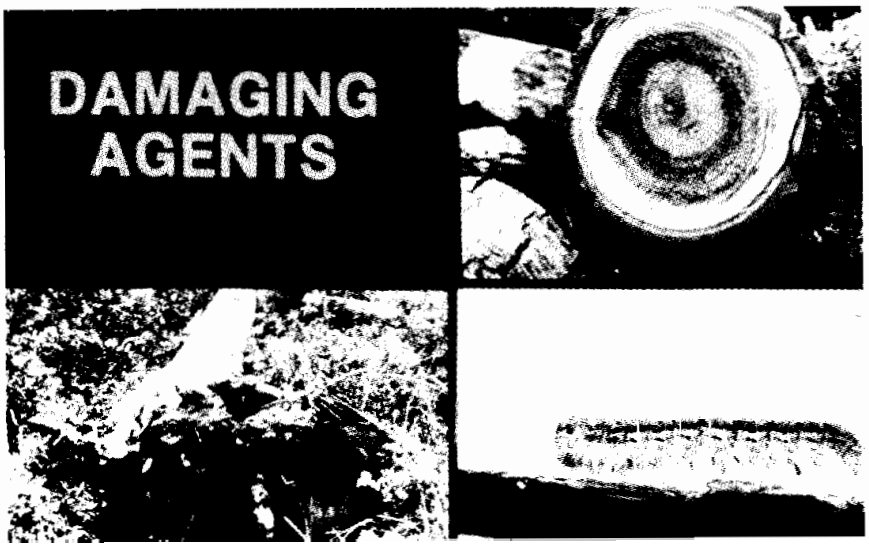
33. regeneration failure.

34. Aspen stands which are being invaded by conifers have the potential to be managed as either conifer or aspen forests. In this program, we will assume all stands will be managed as aspen, whether they are mixed or pure.

34

33

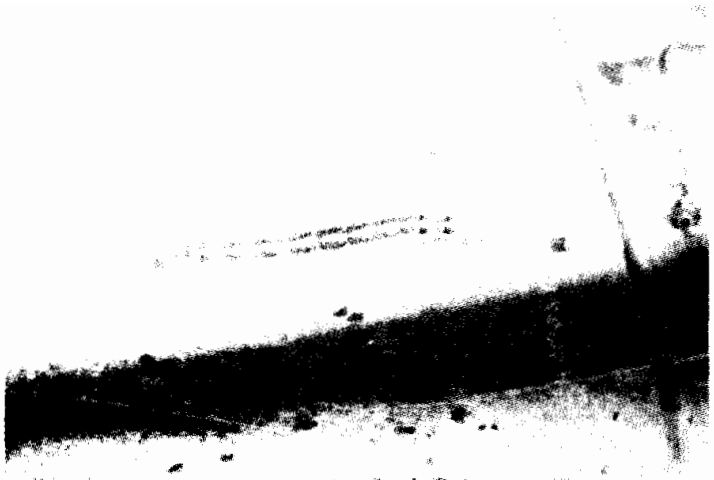
DAMAGING AGENTS



35

35. Let's now discuss some of the factors which can effect the growth of established stands. Rocky Mountain aspen is host to numerous insects and diseases; however, only a few result in substantial damage.

36

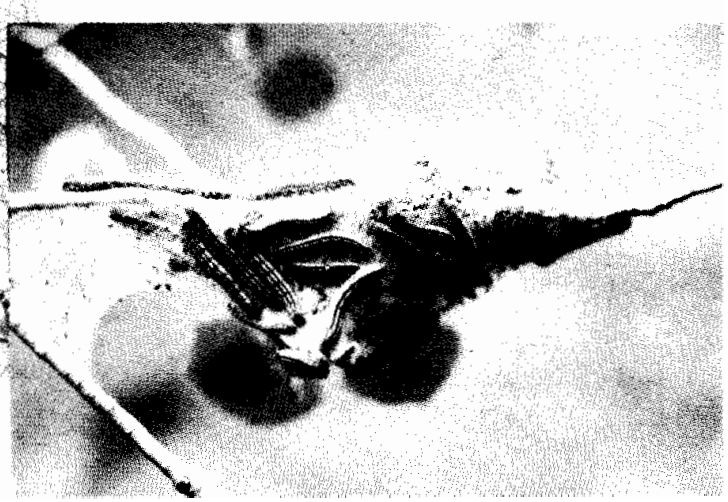


36. The western tent caterpillar is one defoliating insect which can be quite serious.

37. Caterpillars can defoliate large acreages of aspen and cause considerable mortality in heavily infested areas.

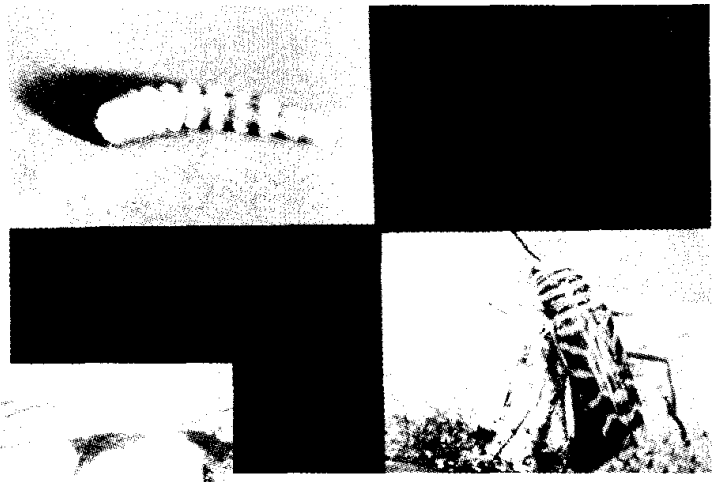
38. Biologic control of new outbreaks is possible through aerial application of a bacteria—*Bacillus thuringensis*—in a water suspension spray.

37

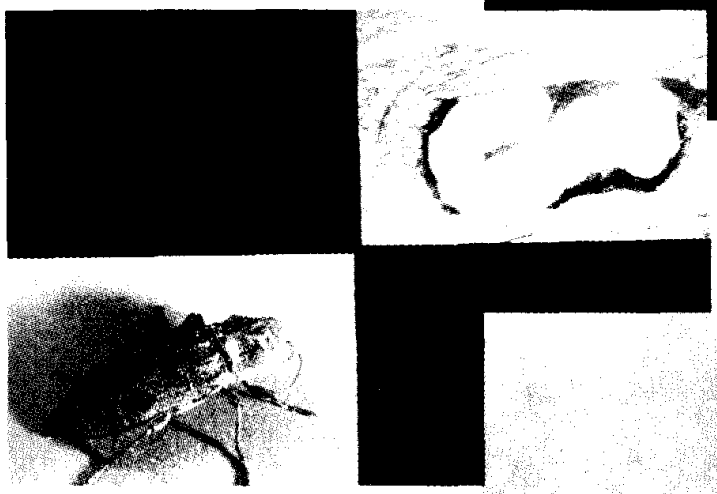


38

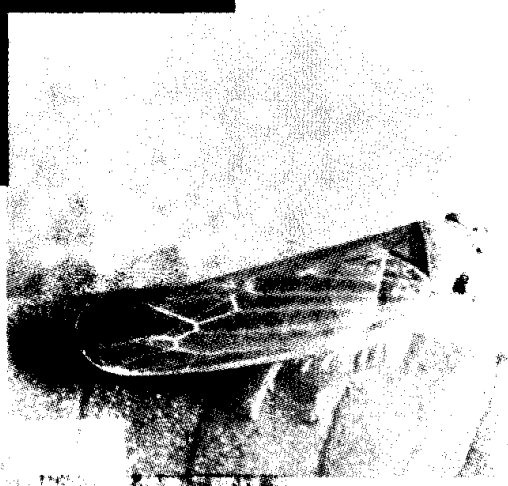
39



40



41



42

39. Several species of boring insects can lower the product value of aspen and infect trees with cankers and other diseases.

40. Roundheaded and flatheaded wood borers damage aspen suckers on poor sites. Their tunnels weaken stems and cause them to break.

41. Three species of leafhoppers infest aspen. They lay their eggs in slits cut in succulent twigs, and the nymphs feed on leaves when they hatch.

42. While canker diseases don't usually affect the majority of the stems in a stand, they can kill and deform trees and cause serious losses in high value stands. Four species of cankers commonly infect trunk wounds.

43

44

45

46

43. This stem is infected with *Hypoxylon* canker. It is easily recognized by the checkered pattern of infected bark. Hypoxylon is rarely serious in the Rockies.

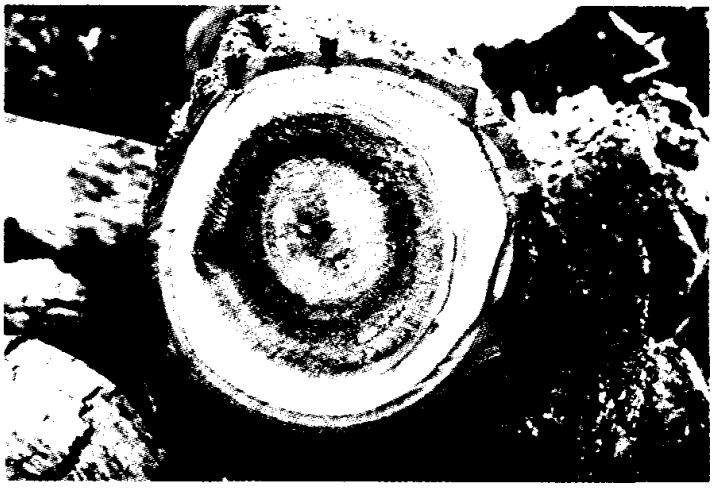
44. *Cenangium*, or sooty-bark, canker is a major cause of aspen mortality in the West and can kill trees quickly. It can be identified by the concentric pattern of dead bark and the sooty residue on dead inner bark.

45. *Cytospora* canker is a relatively slow growing canker, found mostly on weakened trees.

46. The reddish-brown infected bark and the pimple-like pycnidia, or fruiting bodies, on the bark surface identify *Cytospora*.

47

48



49

47. *Ceratocystis,* or black, cankers are large, slow growing, target-shaped cankers. They cause considerable deformity, but are seldom fatal.

48. *Cryptosphaeria* cankers have recently been found in the Rockies and may be potentially serious. These rapidly growing cankers, which can kill stems in a few years, cause discoloration and decay of the stem.

49. Other organisms also cause decay in aspen. In fact, decay is the most serious cause of volume loss and mortality in our stands. The false tinder fungus, shown here, usually enters the stem through a wound or broken branch. Stems older than 100 years of age have the highest rates of infection. But, western aspen does not appear to be as rot prone in its younger years as aspen elsewhere.

REGENERATION

50

50. The most important thing to remember about aspen silviculture is that it does not regenerate the same way conifers do.

51

51. Here in the West, aspen reproduces almost exclusively by suckering, where a number of stems are produced asexually from a parent root system. Suckers are produced when overstory stems are removed or die. This causes a hormonal imbalance, which stimulates buds located just below the soil surface on lateral roots to sprout and grow.

52. Aspen does produce crops of viable seed, but they need bare mineral soil and a constant supply of moisture to germinate and survive. These conditions occur so rarely that, from a management standpoint, root suckering is the only practical way to regenerate our aspen.

52

53

54

55

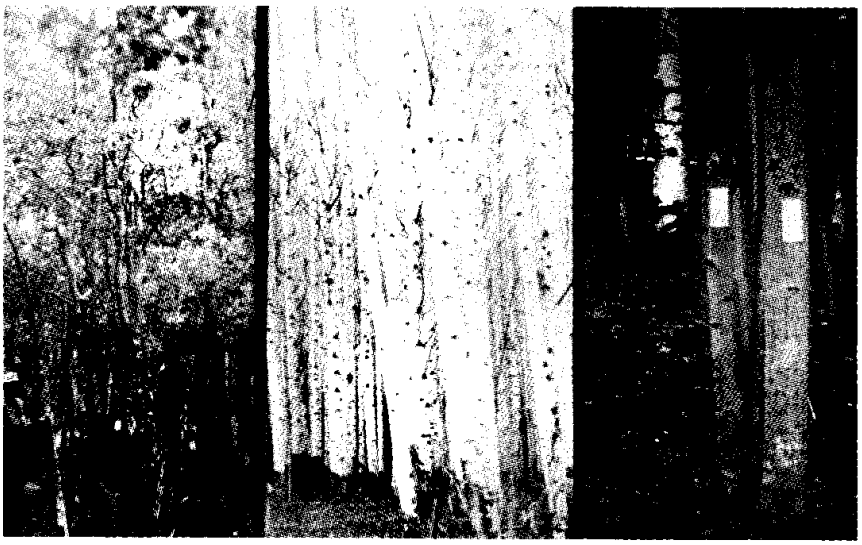
56

53. As a result of this vegetative regeneration, a genetic individual is not a single stem as in conifers, but a group of genetically identical stems (or ramets), which are referred to as a clone.

54. Thus, an entire mountainside of aspen may contain only a few genetic individuals.

55. Although stems within a clone are genetically identical, clones can often be recognized from their neighbors by differences in autumn leaf color. . .

56. . . . and variations in time of leaf flush in spring. Within a stand, clonal boundaries can also be distinguished by careful observation of. . .



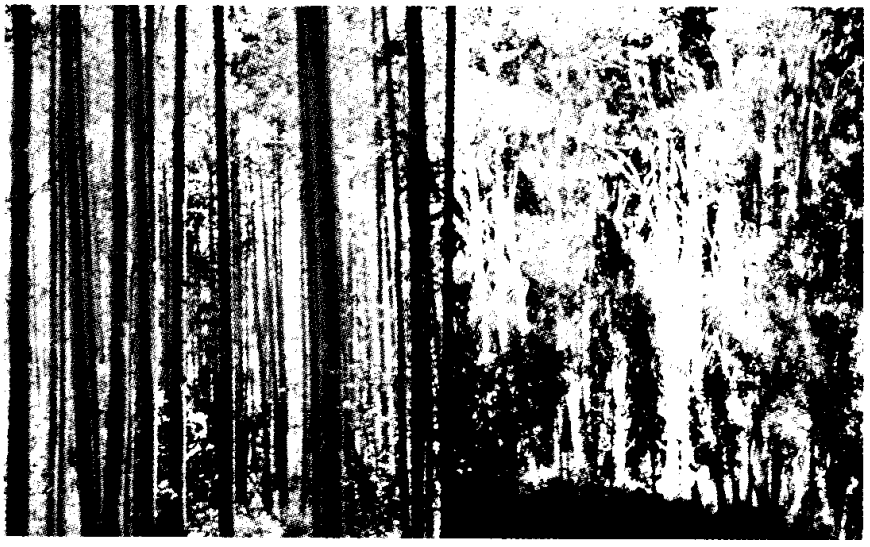
57

58

57. . . . bark color, . . .

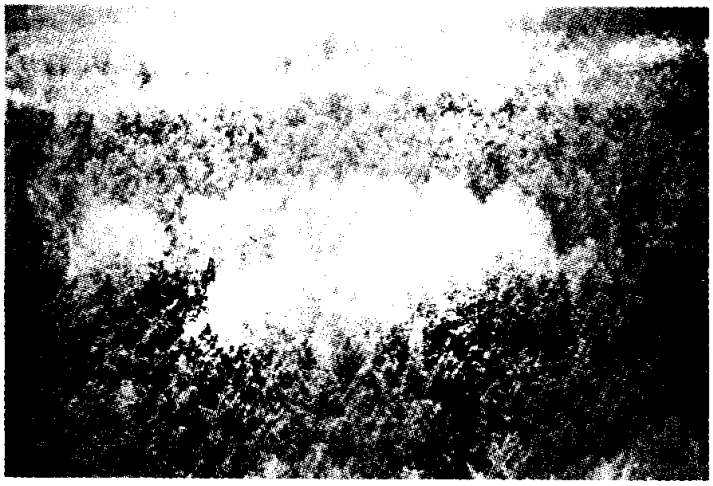
58. . . . branching habit, . . .

59. . . . stem form, . . .



59

60



61

60. . . . suckering ability, . . .

61. and leaf texture. Such characteristics can be important.

62. For instance, cutting a clone with poor stem form will only produce another stand with the same characteristics.

62

TOLERANCE TABLE

Aspen Bristlecone pine Limber pine	*Very Intolerant*
Lodgepole pine Pinyon pine Ponderosa pine	*Intolerant*
Blue spruce Douglas-fir	*Moderately Tolerant*
Engelmann spruce White fir	*Tolerant*
Subalpine fir	*Very Tolerant*

63

63. Aspen is a sun loving species. It is very intolerant of shade, and taller stems will soon outgrow their neighbors. This restricts the development of shorter stems or those affected by disease, giving aspen stands the ability to thin themselves over time.

64

64. Use of an existing mature root system also allows fast initial growth, as this 10-year-old sucker illustrates.

65. The degree of overstory disturbance necessary to cause suckering varies from clone to clone.

65

66

67

66. Multistoried clones have suckered with little or no disturbance to the original overstory. But, a lack of understory sprouts does not indicate an inability to sucker, because...

67. ...browsing, disease, and other factors may eliminate suckers as rapidly as they are produced.

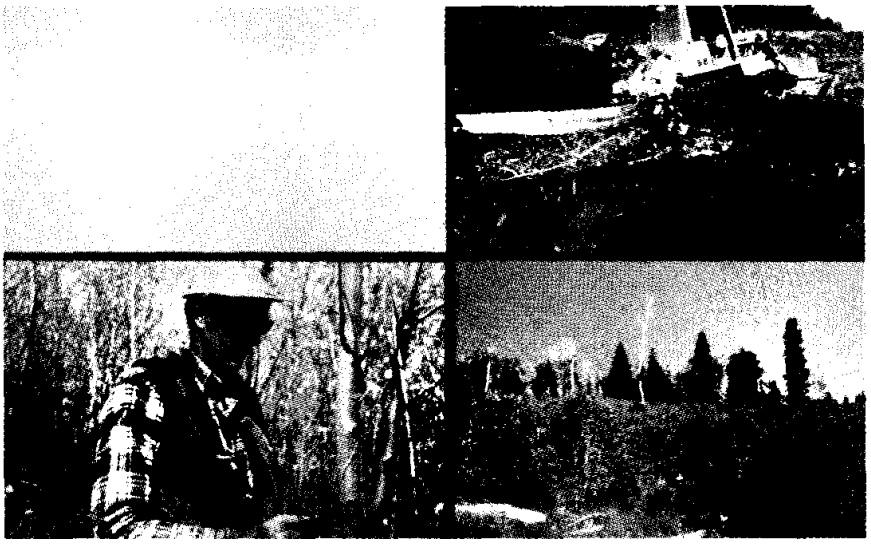
68. Other clones show no evidence of sucker production, even in advanced stages of overstory decline.

69. However, nearly all clones will sucker if all the overstory stems are removed at once and the area is protected from browsing animals.

68

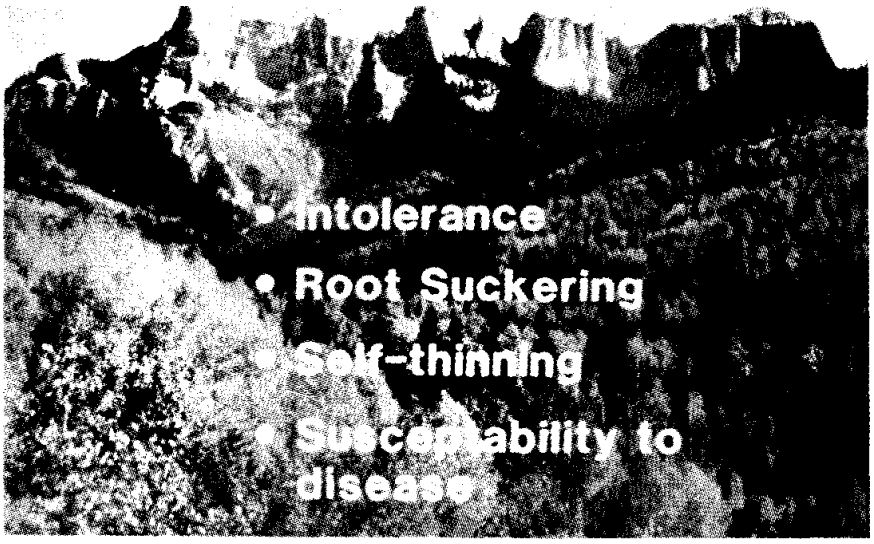
69

SILVICULTURAL SYSTEMS FOR ASPEN REGENERATION



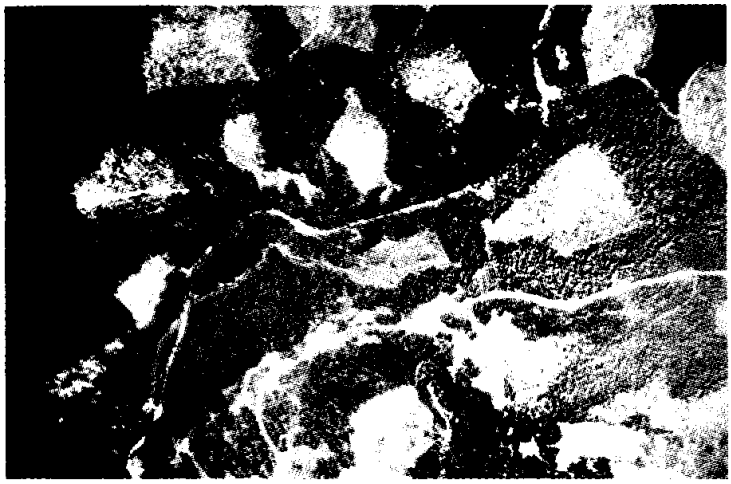
70

70. Before we move on to discuss specific methods of regenerating aspen in the Rocky Mountains and Southwest, let's review the silvical requirements we need to consider in selecting a regeneration method.



71

71. Aspen is intolerant of shade, it reproduces through root suckering, it is self thinning, and it is susceptible to disease infections which enter through wounds in the bark. We should also remember that suckering is usually proportional to the amount of overstory disturbance and will be heaviest within the first 3 years after treatment.



72

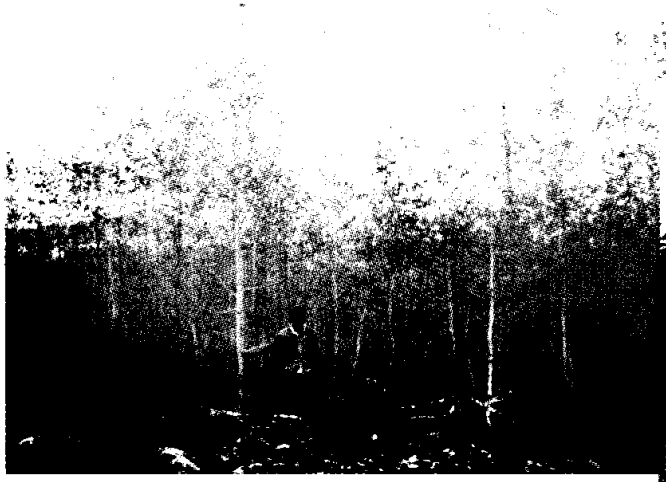
73

72. These characteristics ideally suit aspen to management by an even-aged silvicultural system using clearcutting or other regeneration methods,. . .

73. . . .which completely remove the existing overstory in one step and eliminate the chance of residual stem infection.

74. Because regeneration does not depend upon seed dispersal, treated areas should be large enough and numerous enough to accommodate livestock and wildlife use, yet, still conform to visual resource requirements.

75. Because aspen is an important visual resource that sharply contrasts with other vegetation, regeneration units should be shaped to blend into the natural forms in the landscape. Angular corners and geometric shapes should be avoided.



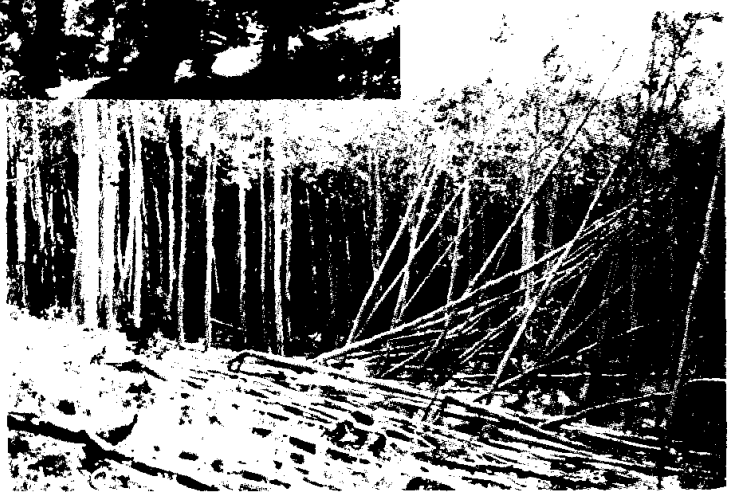
74

75

76

77

78



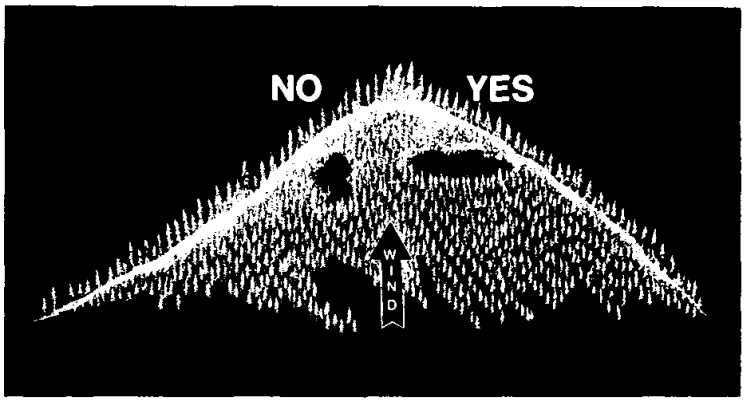
79

76. It is not usually necessary or practical to lay out treatment units along clonal boundaries. Enough suckering to regenerate a stand will usually occur if most of each clone within it is cut.

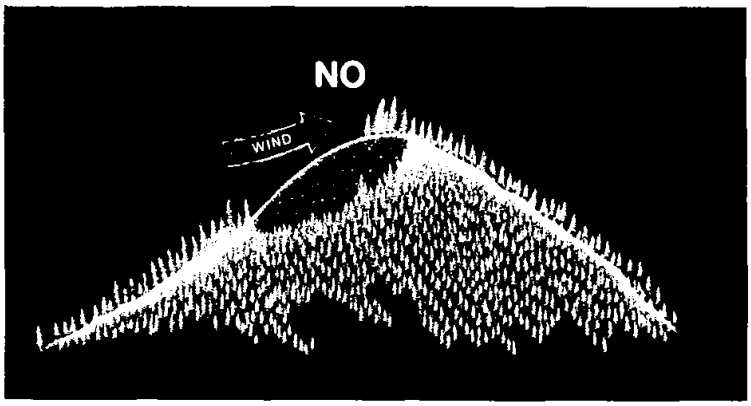
77. Where a stand is being managed for fiber, all nonmerchantable stems and understory saplings should be removed. This will prevent poor quality residual stems from releasing and dominating the new stand.

78. For example, this stem was a 2-inch understory sapling left when this stand was logged 10 years ago. It now dominates the new regeneration and is rotten from the damage it suffered during logging.

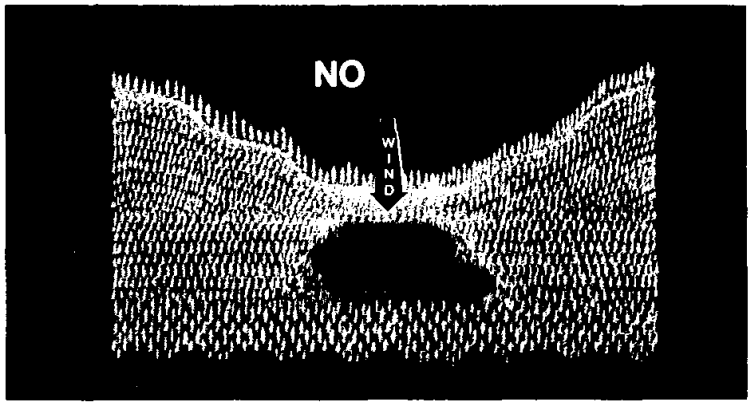
79. Like the conifer species we discussed in the other slide-tapes in this series, aspen is a shallow rooted species which can windthrow. The same rules need to be followed when laying out units to be cut in aspen.



80



81



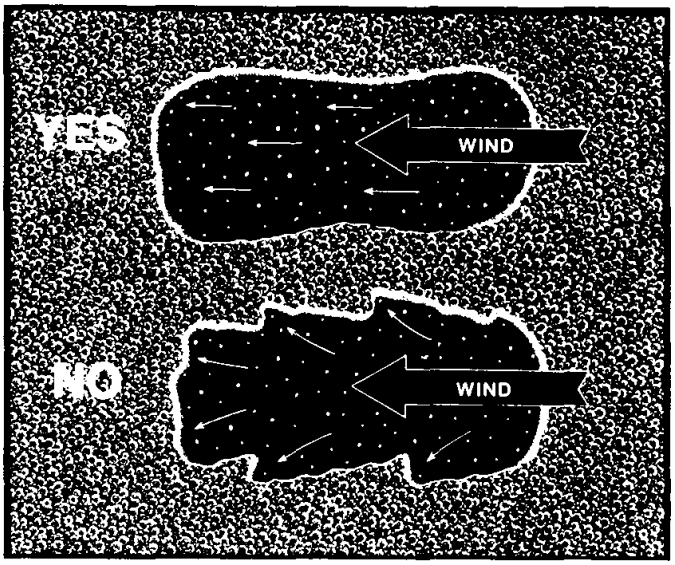
82

80. Avoid laying out openings parallel with the direction of the wind, as shown on the left of this slide. Instead, lay them out with the narrow dimension exposed to the prevailing wind, as we see on the right.

81. Do not place boundaries on ridgetops. . .

82. . . . or directly below saddles in ridges, where wind vortexing occurs.

83. Irregular shapes, without sharp wind catching indentions, will also reduce blowdown.



83

84

85

84. Another regeneration alternative is the use of fire. Although pure aspen stands usually do not burn well,. . .

85. . . .burning can be successful under extremely dry conditions. . .

86. . . .and in stands with enough fuel to carry a fire through the aspen. Stands on poor sites with oily shrub understories usually burn well. But, weather will often limit the opportunities to use fire.

86

87

88

89

90

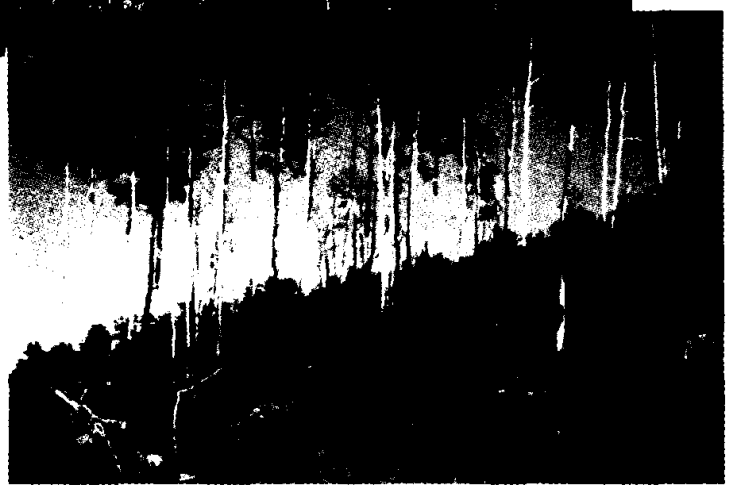
87. Bulldozing is another method of aspen regeneration which may work if applied properly. Note how the operator is tipping the trees over and not cutting into the soil and disturbing the lateral root system of the clone.

88. Here is the same area 3 years later. More than enough roots were left to restock the stand.

89. But, leaving all the bulldozed overstory as slash on this adjoining area limited the suckering response. Heavily stocked stands should not be just cut or bulldozed and left on the site, without at least some slash disposal.

90. It is also possible to regenerate aspen with herbicides by killing enough of the overstory to stimulate suckering. Aerial application, ground spray, or individual stem injection could be used.

92



93

91. Herbicides do not usually kill all the overstory at once.

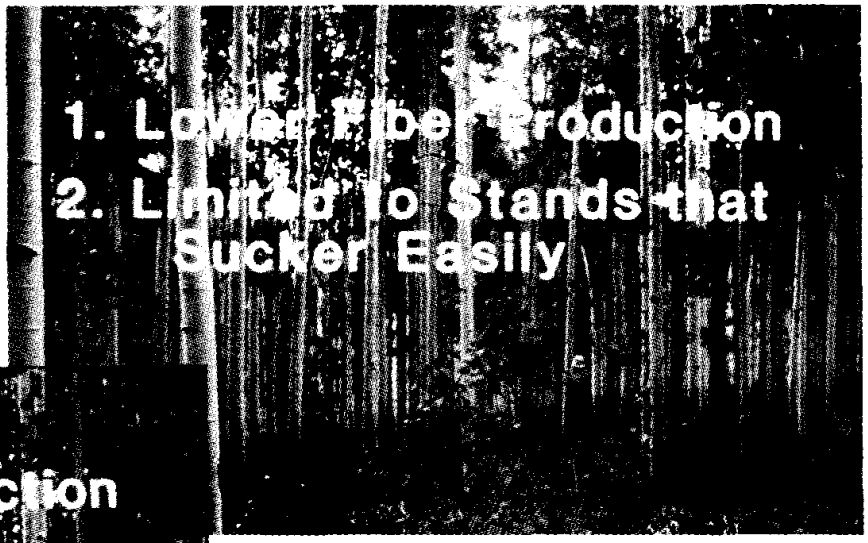
92. The result is a stand that includes at least two age classes and provides wildlife habitat characteristics that are present in naturally occurring multistoried stands. Remember, herbicide use should be carefully planned and must comply with all Federal, State, and local regulations.

93. It may be necessary to use partial cutting methods in some aspen stands if a portion of the original stems should remain for wildlife habitat or other purposes. Individual tree or group selection cutting methods can be used; however, there are several drawbacks to using an uneven-aged silvicultural system in aspen.

94. Such cutting methods will not maximize fiber production. In fact, the resulting stands will be essentially unmanageable for fiber.

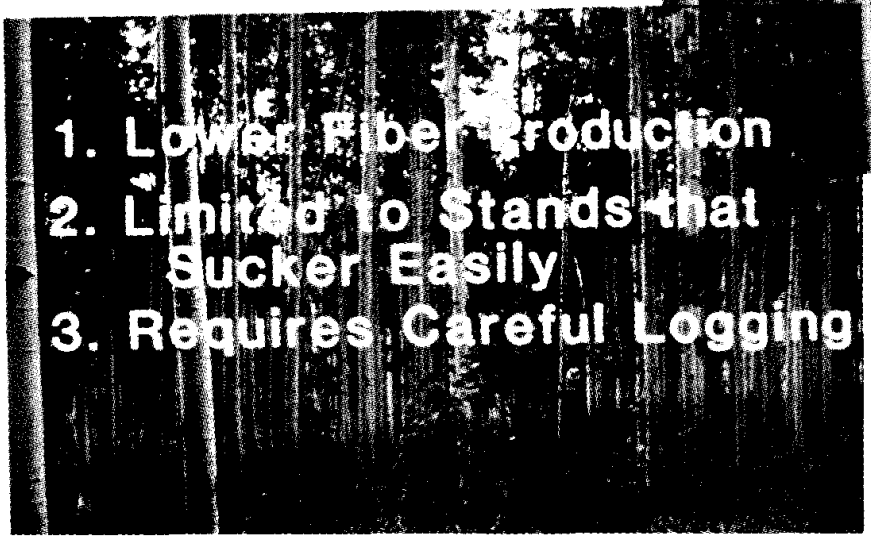
94

95

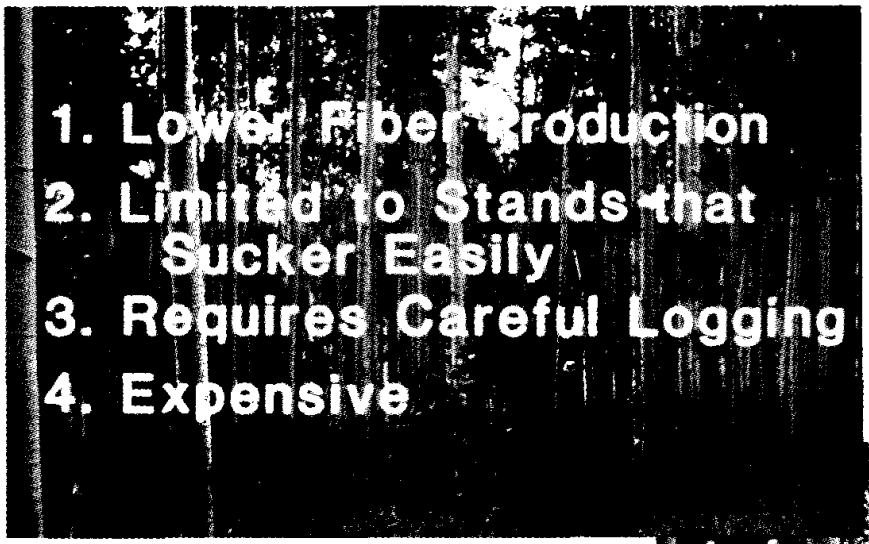


95. Partial cutting methods are limited to clones which will sucker easily. Identifying clonal boundaries and predicting suckering ability will be critical.

96



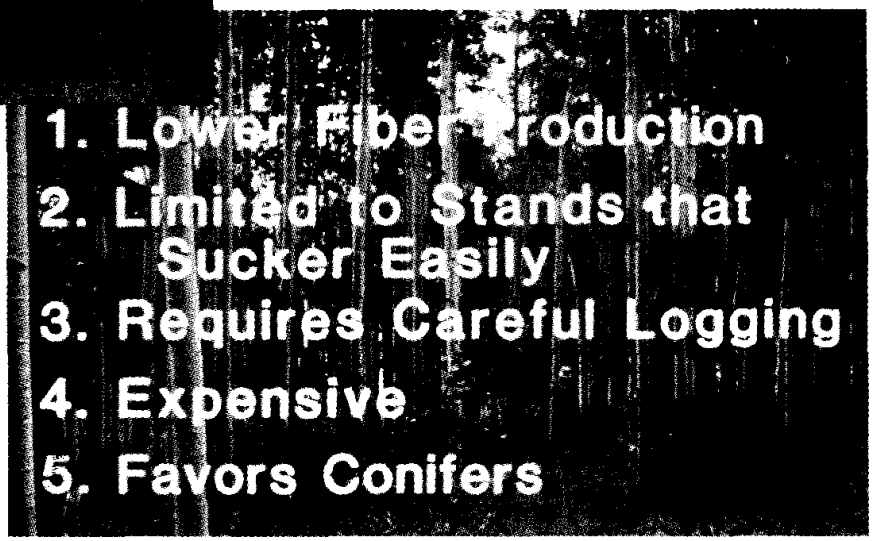
96. Residual stems left after harvest are likely to be damaged and become infected with disease, causing many to die. Any merchantable volume these stems contain must be sacrificed. A future entry to harvest these stems will damage the new stand, making it susceptible to disease.



97

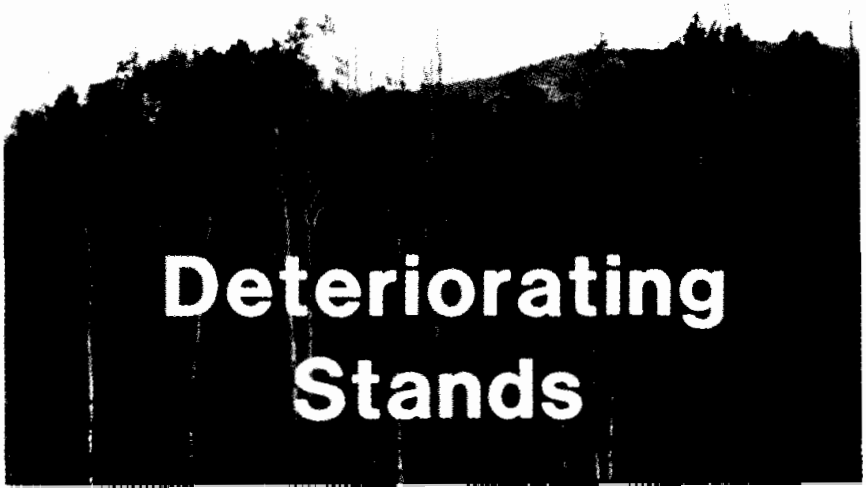
97. Layout, marking, and logging costs will be extremely expensive because of the care needed to avoid residual stem damage.

98. If conifers are present, uneven-aged methods will accelerate replacement of aspen by the conifers.


1. Lower Fiber Production
2. Limited to Stands that Sucker Easily
3. Requires Careful Logging
4. Expensive
5. Favors Conifers

98

DETERIORATING STANDS



99

99. As we mentioned earlier, most aspen stands will attempt to regenerate themselves if the overstory is destroyed or removed. But, sometimes a clone needs a little additional help.

100

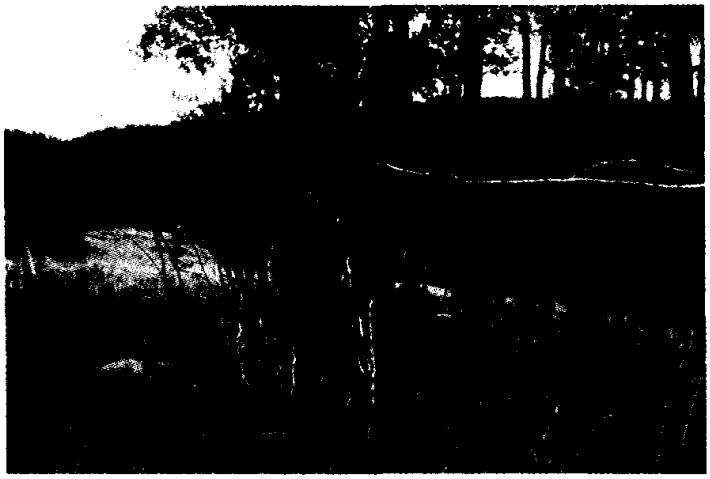
101

100. We need to be particularly cautious when regenerating stands which occur on marginal sites in valuable wildlife habitat. . .

101. . . .or areas of high scenic value. Like this stand, they are frequently isolated, poorly stocked, have many damaged stems, and show little evidence of suckering.

102

103



104

102. Deteriorating stands may also show evidence of insect and disease attack,. . .

103. . . .heavy understory browsing,. . .

104. . . .and root compaction or trampling damage.

105

106

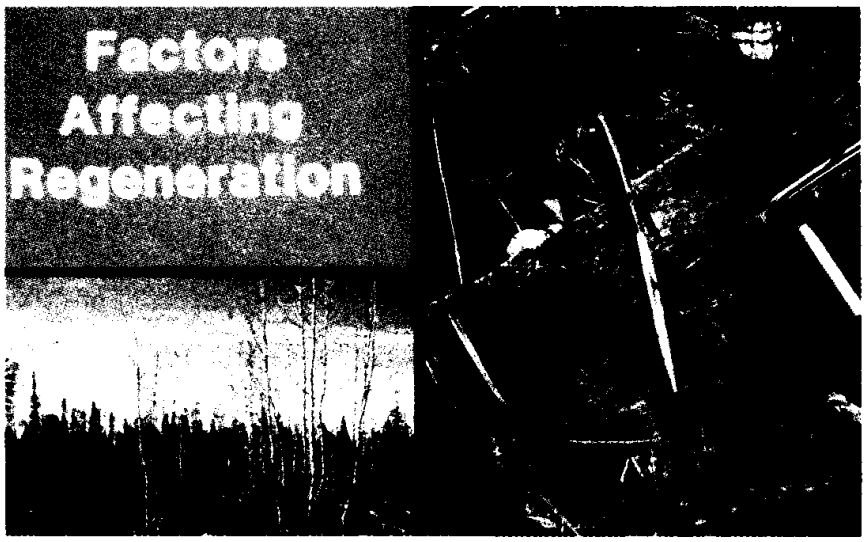
105. If we cut these stands, suckering is likely to be sparse because of the weakened condition of the root system.

106. Additional protective measures, such as fencing or locating salt and water to draw animals away, may be required for a few years to allow suckers to become established.

107. In stands where conifer invasion has caused stand deterioration, treatments should provide for the eventual removal of conifers if the area is to be managed as an aspen stand.

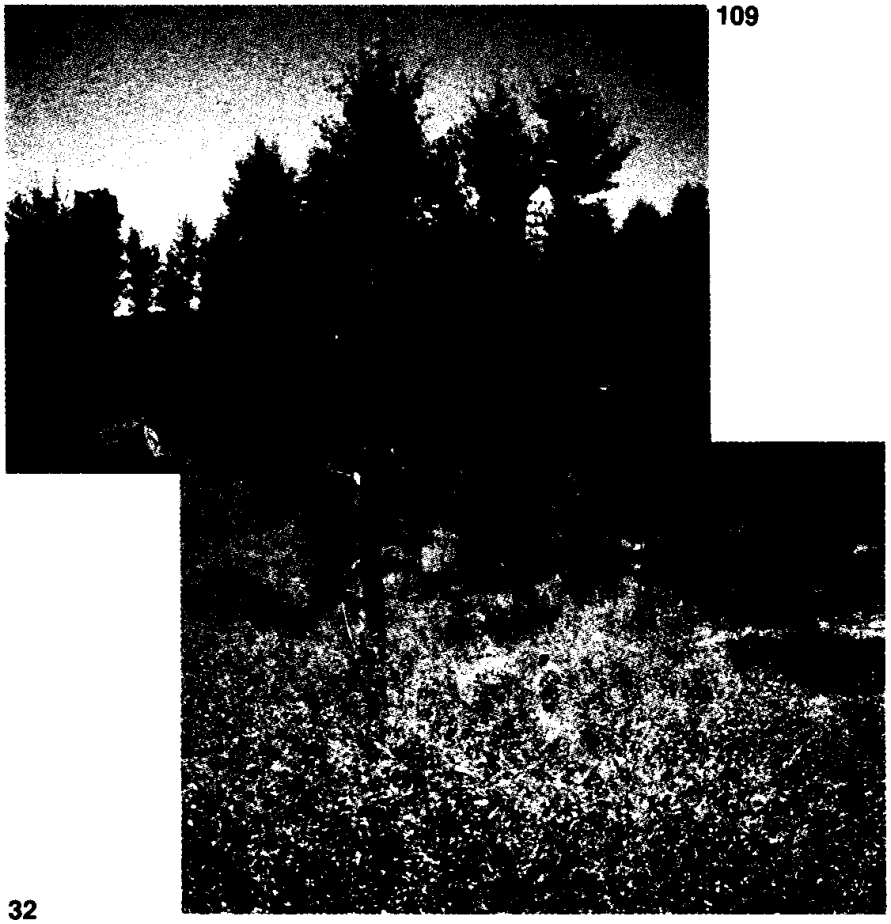
107

FACTORS AFFECTING REGENERATION



108

108. In spite of the apparent ease of regenerating Rocky Mountain aspen, there are a number of factors which can limit regeneration success.



109

109. How many suckers are needed to successfully regenerate an aspen stand? The answer is determined by the management objectives for the stand. If our objective is to just maintain the presence of aspen on a site, relatively few suckers may be required.

110. On the other hand, our goal should be as many suckers as possible if we intend to provide forage for big game on spring, fall, or winter range.

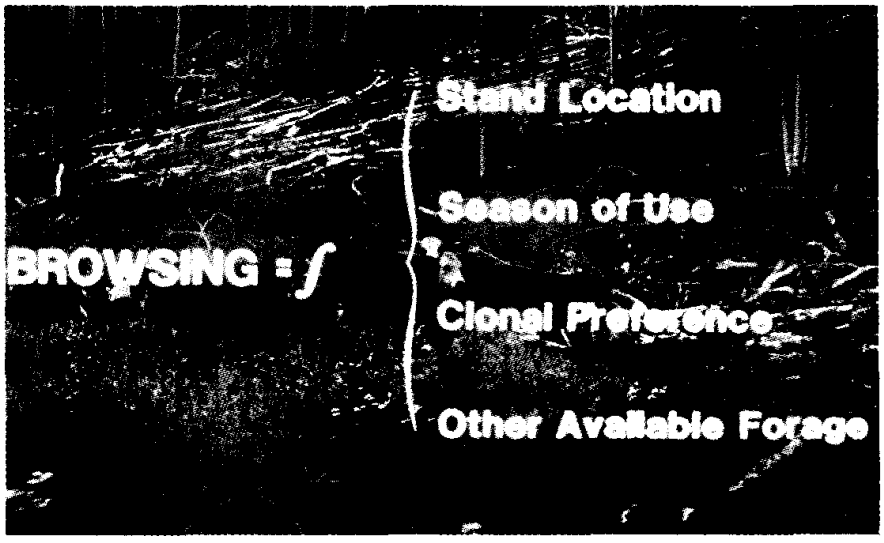
110

111

111. An existing mature stand of tall, straight stems is no guarantee of successful regeneration. But, it does indicate what to expect if suckers remain undamaged and free to grow.

112. We do know animal browsing affects sucker quality, and heavy damage is possible. Browsing is usually a problem for only a few years until suckers grow beyond reach of the animals, but stands can be wiped out by heavy browsing for several years.

112



113

113. The amount of aspen browsing can depend upon stand location and animal stocking rates, season of use, preference of some clones over others by animals, and other available forage. However, it does appear that browsing damage is reduced as more acres within a management unit are treated. Where regeneration areas are large enough to accommodate animal use, undamaged suckers survive.

114

115

114. In some cases, fencing or allotment rotation will be necessary to achieve successful regeneration.

115. Small animals can also affect regeneration success. A high vole population girdled suckers and killed this young stand.

116. Snow damage has recently been described in regenerated stands. The weight of the snowpack can break stems. . .

117. and strip branches from suckers. Snow damage does not appear to occur every year or on all locations,. . .

116

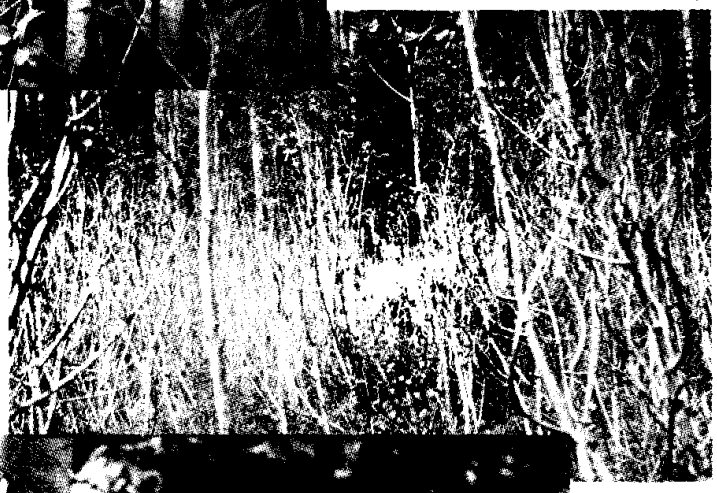
117

118

119

118. and suckers can ultimately recover from some damage.

119. But, repeated snow damage can seriously affect stand quality.



120

120. Disease outbreaks have the potential to wipe out even vigorous, established stands and have caused regeneration failures in some localities.

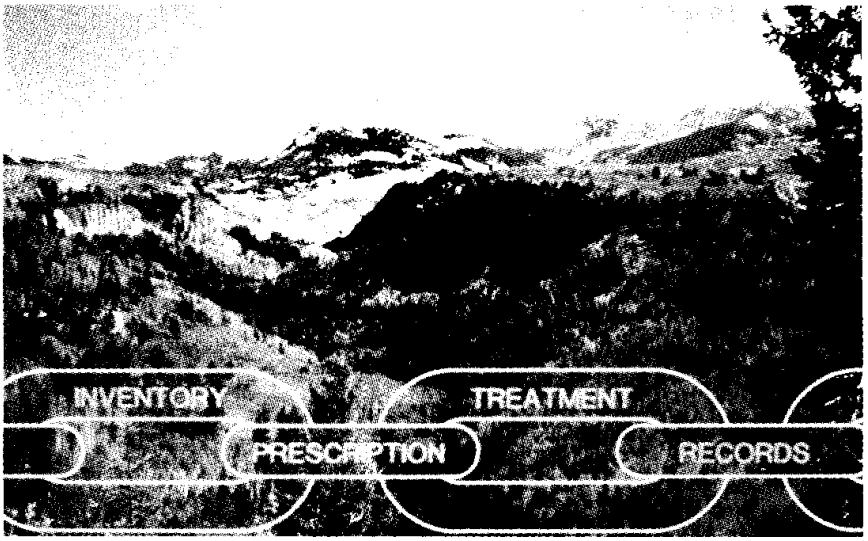
121. Habitat type can be important in estimating the success of aspen regeneration. For instance, aspen is typically replaced by conifers sooner on white fir habitat types than on subalpine fir or Engelmann spruce habitat types. . .

122. . . .and vegetation associations, which indicate a high water table should be avoided.

121

122

CONCLUSION



123

123. (MUSIC UP). As you have seen throughout this program, the successful silvicultural treatment of aspen in the Rocky Mountains and Southwest depends upon several operations, which are linked together much like a chain. A breakdown or failure of any will result in the failure of the entire process.

124. First, we must obtain accurate inventory information . . .

125. . . . and input from other disciplines affected by aspen management activities is necessary to write an accurate prescription.

124

125

NOTES

NOTES

☆ U.S. GOVERNMENT PRINTING OFFICE:1986—671-604

Other titles in this series include the following:

Overview to Silvicultural Systems in the Central Rocky Mountains (RM-TT-1).

Silviculture of Spruce-Fir Forests in the Central Rocky Mountains (RM-TT-2).

Silviculture of Lodgepole Pine in the Central Rocky Mountains (RM-TT-3).

Silviculture of Ponderosa Pine in the Central and Southern Rocky Mountains (RM-TT-4).

Silviculture of Mixed Conifer Forests in the Southwest (RM-TT-6).

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE